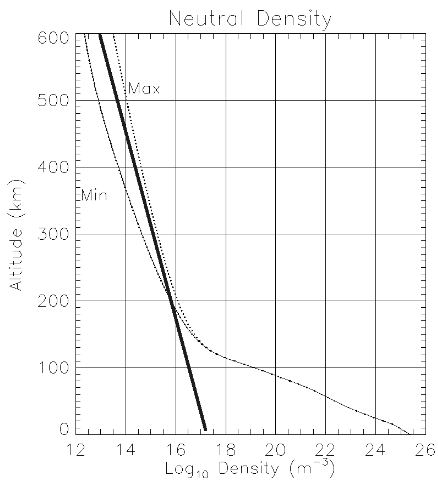
6-1 Estimate the scale height above 200 km altitude, using the information in Figure 6.5b.



I estimate $n = 2\times10^{17}$ at h = 0 km, and $n = 1\times10^{13}$ at h = 600 km. The formula is:

$n = n_o e^{-\frac{h}{H}}$. Given a start at h = 0, we get

$$1\times10^{13} = 2\times10^{17}\ e^{-\frac{600\text{ km}}{H}}$$

$$e^{\frac{600\text{ km}}{H}} = 2\times10^{4}$$

$$\frac{600\text{ km}}{H} = 9.903$$

H = 60.6 km

This is similar to the values in Figure 6.4.

Calculate the scale height for N_2 using a temperature of 1000 K (ignore the altitude dependence of g).

$$H_p = \frac{kT}{\mu m_p g} = \frac{1.38\times10^{-23}\bullet1000}{28\bullet1.67\times10^{-27}\bullet9.8} = 30.1\text{ km}$$

It appears that N_2 is not the dominant component..

6-2 If the temperature of the upper atmosphere doubled (from 1000 to 2000 K), how would the number density at 700 km altitude change (give a number). In order to do this you should use the scale height calculated in problem 1, assume the atmosphere is isothermal, and that the density at 200 km does not change. (This type of temperature increase is the source of some of the changes seen in Figure 6.7)

Badly written problem…..
Here is what I had in mind.
Begin at 200 km, with the formula:

$n = n_o e^{-\frac{(h-200)}{H}} = 10^{16}\ e^{-\frac{(h-200)}{30}}$ (altitudes and scale height both in km for convenience). At an altitude of 700 km, this would give:

$$n = 10^{16}\ e^{-\frac{(700-200)}{30}} = 5.8\times10^{8}$$

If the temperature doubles, the scale height doubles, and we get.

$n = 10^{16}\ e^{-\frac{(700-200)}{60}} = 2.4\times10^{12}$, and increase by a factor of 4160 - pretty substantial.

6-3. A) If the temperature of human skin is 98.6 F, at what wavelength does the blackbody radiation from skin peak? Which IR window is best for night time surveillance of humans?

From Chapter 1, we have $\lambda_{max} = \frac{a}{T}$ where $a = 2.898 \times 10^{-3} \ (\text{m K})$.

The conversion from F to K is: $T\,(C) = \frac{5}{9}\left(T(F) - 32\right) = 37$

$$T(K) = 37 + 273 = 310$$

$$\lambda = \frac{2.898 \times 10^{-3}}{310} = 9.35 \times 10^{-6} \ \text{m} \quad \text{or } 9.35 \text{ microns}$$

The window from 8-9 microns looks like a good bet.

B) If the average temperature of the stacks on a surface ship is 750 K, at what wavelength does blackbody radiation from the stacks peak? Which IR window is best for night time surveillance of ships?

$$\lambda = \frac{2.898 \times 10^{-3}}{750} = 3.86 \times 10^{-6} \ \text{m} \quad \text{or } 3.9 \text{ microns.}$$

The window from 3-4 microns looks like it might work.